



Cost Estimating Initiatives in NASA Project Management

**NASA Program Management Challenge Conference
March 21-22, 2006
Galveston**

**David Graham
NASA Headquarters Cost Analysis Division**

March 22, 2006



Agenda

- **Background**
 - NASA cost issues
 - Summary of GAO and Aldridge recommendations
- **Overview of NASA's Cost Initiatives**
- **Status report**



Background

- **Nearly all NASA projects sustain cost overruns**
- **Cost risks are not explicitly addressed in most project estimates**
- **Quality of cost estimates vary**
- **Actual costs of projects not routinely collected in consistent cost elements (WBS) or disseminated**
- **Many projects do not use Earned Value Management information to manage cost and schedule progress**



Background (Concluded)

Between 2003 – 2004, GAO and Aldridge evaluations recommend improvements in cost estimating

- Establish an independent estimating organization similar to OSD's Cost Analysis Improvement Group
- Develop independent parametric risk-based life cycle cost estimates at major milestones
 - Use baseline descriptions of projects using a Cost Analysis Requirements Description (CARD)
 - Use a common WBS
 - Collect and disseminate actual project cost and schedule data
- Prohibit projects from proceeding past milestones without above
- Implement Earned Value Management (EVM) to continuously monitor cost and schedule performance
- Staff and support expanded cost estimating and EVM functions



Overview of NASA's Cost Initiatives

Educate Stakeholders

- Responses to GAO
- Workshops & Training
- Cost Estimators Career Plan
- Cost Estimating Handbook
- CAD/OCE Road Show
- Cost Symposia
- Host CASG web site

Revise Policy

- NPR 7120.5C

- CCRM
- CADRe
- WBS
- ICE

Implement Policy

- Identify projects & events
- Coordinate with PEs & PMs
 - Explain need and process
 - Stay engaged with PM
- Ensure compliance with policy
 - Attend Acquisition Strategy Meetings
 - Review RFPs

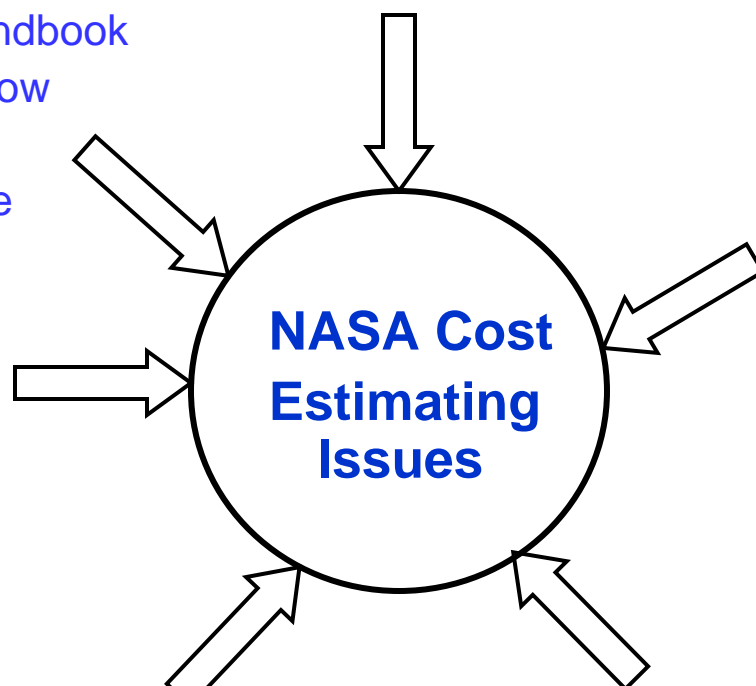
Develop Quality Estimates & Analyses

Ensure Quality Estimates

- Review & reconcile estimates
- Risk-based & funded @ 70th% CI
- Fund & disseminate cost research
- Provide state-of-art tools

Collect & Disseminate Project Data

- Fund CADRe development
- Build & deploy ONCE database
- Change FAR Supplement





Revise Policy

- **Drafted and coordinated language NASA Policy Requirements NPR 7120.5C**
 - Conducted workshops at centers during FY05
 - Developed procedures to implement Cost Risk Management (CCRM), Cost Analysis Requirements (CADRe), Work Breakdown Structure (WBS), and Independent Cost Estimates (ICE)
 - CCRM
 - Must identify and quantify risk
 - Provide data to allow PM to manage risks through EVM
 - CADRe
 - Provides detailed description of project for Independent Cost Estimates
 - Provides actual cost within a consistent WBS
 - Required 5 times during project life and provides information to explain cost growth
 - Specified when ICEs must be done
- **Policy revisions continuing with NPR 7120.5D**
 - Currently being drafted—expected publication by Summer 2007



Continuous Cost-Risk Management

A cost management architecture providing:

- Early identification of medium- and high-risk WBS elements
- Communication of WBS risk elements to project managers for focused cost management
- Emphasis on WBS risk elements in cost estimating
- Post-cost estimate tracking of identified risk WBS element using EVM system
- Updates, collection and archiving of technical and cost data for cost model improvement

Incorporated in NPR 7120.5C

Application
Steps 9-12

Preparation
Steps 1-5



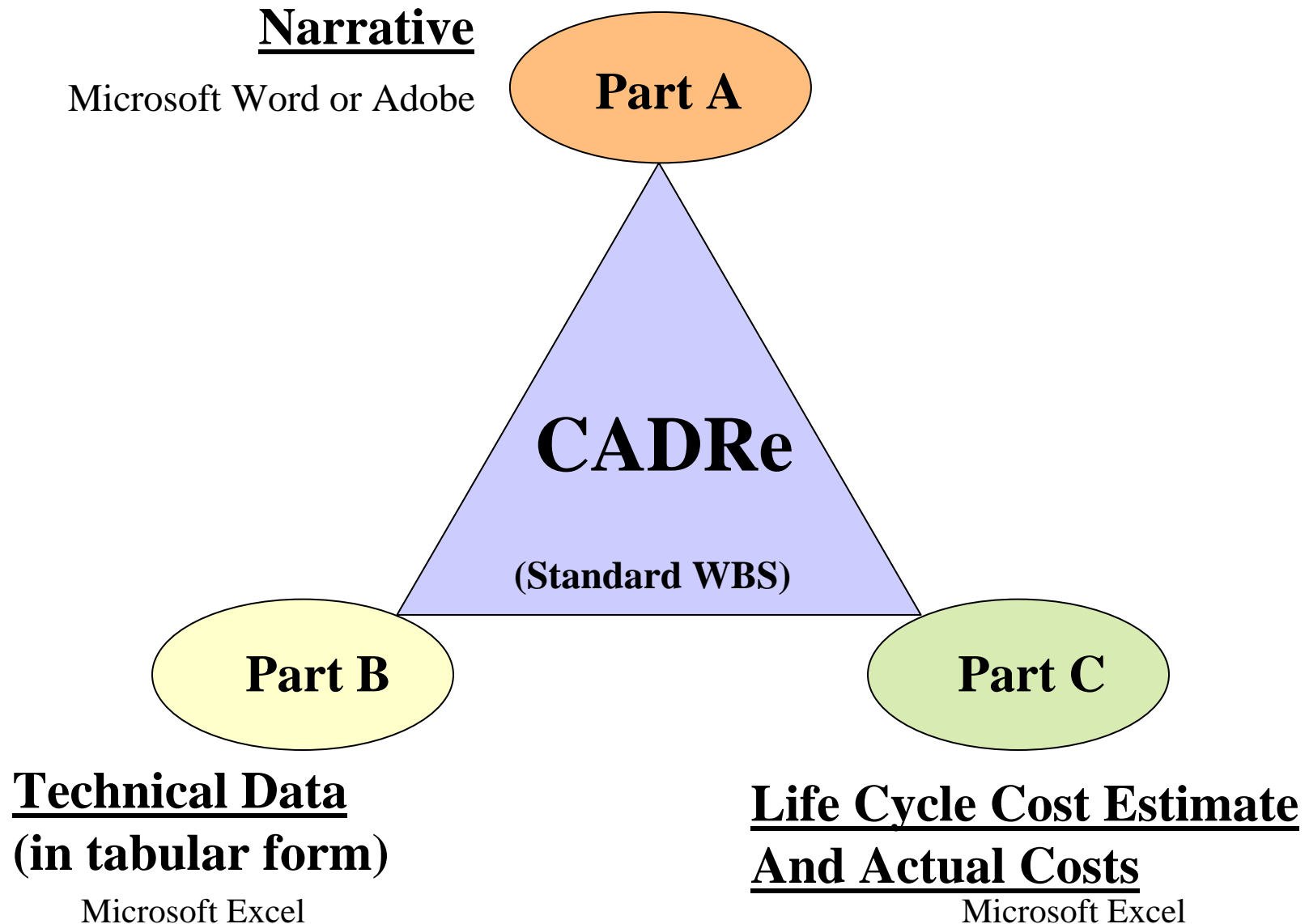


What is the CADRe?

- **The CADRe is a document that:**
 - Describes a NASA project, at a given point in time, in sufficient detail to allow an independent entity to estimate the project's life cycle cost
 - Captures the NASA project's projected and actual life cycle costs within the NASA approved Work Breakdown Structure (WBS)
 - Describes changes to the project since the previous CADRe submission
- **The CADRe is not a project monitoring tool for external organizations**



CADRe Structure





Why is the CADRe Needed?

- **Congress and OMB are requiring us to:**
 - Do a better job of estimating using common project descriptions and historical data
 - Be able to explain reasons for cost and schedule growth
 - Reconciliation for cost estimates between IPAO and the projects
- **Required by NASA Policy Requirement 7120.5C**



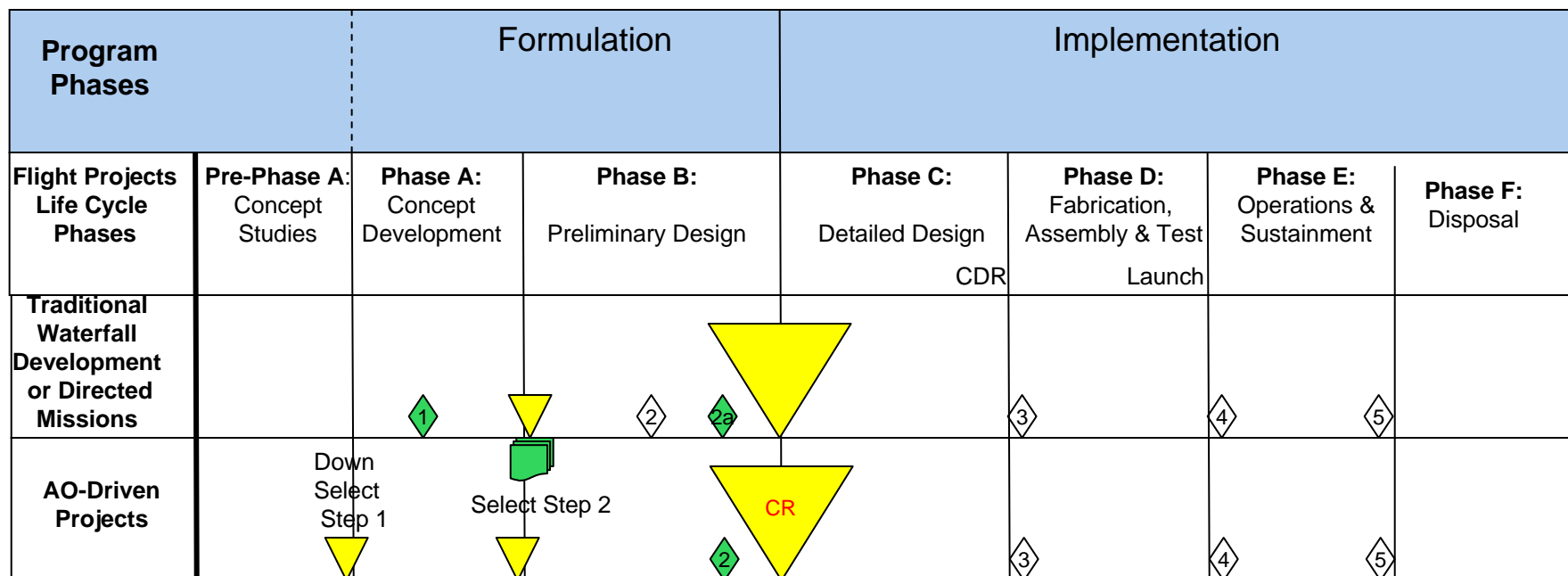
What Types of Projects Require a CADRe?

Priority	Life Cycle Cost		
	LCC<\$100M	\$100M < LCC < \$500M	LCC > \$500M
High	Category II (CADRe Required)	Category I (CADRe Required)	Category I (CADRe Required)
Moderate	Category III	Category II (CADRe Required)	Category I (CADRe Required)
Low	Category III	Category III	Category II (CADRe Required)

CADRes are required for all Category I & II Flight Systems and Ground Support Projects



When is a CADRe Required?



Legend

GPMC Mission Decision Review

CADRe EZ, 90 days prior to decision review (post-competition), or approximately 25 days prior to site field review

Concept Study Report and Winning Proposal

CADRe, Preliminary Parts A & B, 120 days prior to GPMC review, or approximately 60 days prior to site field review

Updated CADRe, Parts A & B 30 days prior to GPMC review; Part C immediately after site field review

Update as necessary 30 days after CDR

CADRe, All Parts 90 days after launch, as built or as deployed configuration

CADRe, Part C only during last year of planned project life



Who is Responsible for the CADRe?

- **The NASA project manager is responsible for the CADRe**
 - Describes the project from a programmatic and technical perspective, the implementation approach, projected risk, and risk mitigation strategy
 - Contains the technical parameters that drive cost
 - Includes project life cycle cost in the project's WBS along with a map the NASA's cost estimating WBS
 - Explains reasons for cost and schedule changes since last CADRe submission



How Should the CADRes Be Developed?

- **HQ/CAD prefers to have the CADRes developed by its support contractors and/or Center's cost staff**
 - Minimizes impact to PM's staff and funding resources
 - Ensures consistency of collected information across projects
- **CADRes developed from readily available information**
 - Concept Study reports and proposals for AO mission at Pre-NAR; directed missions from available documentation
 - PDR presentations, MELs, project schedules, project cost estimates for confirmation review CADRe
 - CDR presentations, updated MELs, refined schedules, updated cost estimate and collected actual costs for the CDR CADRe
 - Launch Readiness Review documents, updated estimated and actual cost reports for Launch CADRe



Proposed Development Approach (Continued)

- **Development principles:**

- Minimize impact to Project Office for each collection point
 - In time for Pre-NAR (PMSR) and NARs (PDR)
 - After CDR and Launch
- CADRes developed from readily available information
 - Concept Study reports and proposals for AO mission at Pre-NAR; directed missions from available documentation
 - PDR presentations, MELs, project schedules, project cost estimates for confirmation review CADRe
 - CDR presentations, updated MELs, refined schedules, updated cost estimate and collected actual costs for the CDR CADRe
 - Launch Readiness Review documents, updated estimated and actual cost reports for Launch CADRe



Who Will Have Access to CADRes?

- **Developed CADRes to date are all contained on CDs and in the possession of HQ/CAD**
- **Plan to develop One NASA Cost Engineering (ONCE) database where CADRe data will be shared among NASA cost estimating & resource stakeholders**
- **ONCE Access Rules**
 - HQ personnel will have access to all CADRe data
 - NASA center personnel will have access to
 - Only their own pre-launch CADRe data
 - All CADRes after missions have been launched



How Will the CADRe Data Be Used?

- **Independent Program Assessment Office (IPAO) will use the data to develop Independent Cost Estimates**
 - Goal is to provide the essential information needed to develop an ICE. We want to collect lowest level of information that is available. CADRes will be developed from this data commensurate with the project phase
 - Should minimize the amount of data requests on the PM
- **NASA HQ Personnel will use data to:**
 - Develop cost estimating relationships to support its role in adjudicating and reconciling project and IPAO estimates before the PMC. Sample uses include:
 - Assess proposed project schedule in light of performance of similar past projects; recommend adjusted schedule and funding needs to PMC;
 - Assess cost estimates in light of variation of actuals costs;
 - Assess extent to which high heritage percentages are achieved; adjust funding accordingly;
 - Assess software development productivity of historical data; adjust funding accordingly;
 - Assess extent to which software is reused; adjust funding accordingly; and
 - Assess extent of software code growth; adjust funding accordingly
 - Analyze reasons for cost growth
 - Provide better answers to OMB and Congress
 - Develop policy strategies to address



How CADRe Data Will Be Used

- **Center personnel may use the CADRe data to:**
 - Update cost models with actuals to better project future similar systems
 - Prepare more realistic cost and schedule estimates from analogous data contained in the CADRes. Sample uses include:
 - Assess proposed project schedule in light of performance of similar past projects; adjust estimates accordingly
 - Assess extent to which high heritage percentages are achieved; adjust estimates accordingly
 - Assess extent to which software is reused; adjust estimates accordingly
 - Assess extent of software code growth; adjust estimates accordingly



NASA Cost Estimating WBS

NASA cost estimating community agreed to a standard WBS down to level 5. Projects must map to this WBS.

Estimators need a common structure for analyzing costs and estimating future similar projects

Partial Listing

System Name
Project Management
Systems Engineering
Safety and Mission Assurance
Science and Technology
Payloads
Instrument n SE/PM/IAT&CO
Instrument n HW
Instrument n SW
Aero-Spacecraft
Aero-Spacecraft SE/PM/IAT&CO
Spacecraft/Orbiter
Spacecraft/Orbiter SE/PM/IAT&CO
Structures & Mechanisms
Thermal Control
Electrical Power & Distribution Group
Guidance, Navigation & Control (GN&C)/Attitude Control
Crew Accommodations Subsystem
Environmental Control and Life Support Subsystem
Propulsion Subsystem
Communications, Command and Data Handling (CC&DH)
SC-Orbiter Flight Software
SC-Orbiter Retirement & Disposal
Entry/Decent Lander (if applicable)



Implement Policy

- **Identified projects and milestones**
 - Identified over 400 CADRe submission events over next several years
 - Identified responsible program executives and project managers
- **Began contacting Program Executives (PEs) and Project Managers (PMs) of current projects and explained requirements**
 - Need for EVM and CADRe
 - Agree on who will develop CADRe and EVM DRD and when
 - Help implement CADRes and EVM
- **Ensure compliance**
 - Attended several acquisition strategy meetings
 - Reviewed Request for Proposals (RFPs) and Announcements of Opportunity (AOs)



Collect and Disseminate Project Data

- **Arranged and funded support to develop CADRes for PMs**
 - Goddard, JPL, Aerospace, and SAIC
 - Completed 8 CADRes, 28 under development, and 101 planned during FY06
- **Make Data Available**
 - Develop central repository
 - Developed and coordinated requirements for a One NASA Cost Engineering Database (ONCE)
- **New Access and Release clauses in NASA FAR Supplement**



Changes to NASA FAR Supplement Summary

- **Background**

- NASA continues to use support contractors (service providers) to perform cost analyses and estimates
- Requires service providers obtain Non-Disclosure Agreements from supplying contractors (data originators) to protect non-disclosure of “confidential” or sensitive information
 - Very expensive and impractical

- **Two New Clauses In All NASA Solicitations and Contracts**

- Release Clause
 - Notifies contractors that NASA may release their sensitive information to service providers that support NASA activities and functions
- Access Clause
 - Will allow service providers access to sensitive information, whenever it is needed to support NASA’s management activities and administrative functions

- **NASA has proposed process in place to handle contracts issued prior to the revised NFS**



Educate Stakeholders

- Maintaining a Cost Estimating Handbook (CEH)
- Workshops with cost estimating and project personnel at centers
 - Feedback on CADRe content and implementation process
 - Agreement on Work Breakdown Structure down to one level below subsystems
 - Reached tentative agreement on technical parameters
- CCRM training sessions at the NASA Cost Risk courses
- Annual cost analysis symposium to exchange new estimating methods and data
- Briefed at Project Management Conferences in 2004 and 2005
- Cost Analysis Steering Group (CASG) meetings with NASA cost estimators
- Creating career development plan
- Planning additional CADRe and cost risk training sessions
- Planning an Educational “road show” with OCE, FY 2006



Ensure Quality Estimates

- **Review and reconcile all major project cost estimates (Cognizant Role)**
 - Reconcile IPAO and project data and methods
 - Ensure cost estimates are risk based
 - Recommend funding at an appropriate confidence level
 - Assess quality of parametric inputs and assumptions
 - Determine if cost estimates are reasonable when compared to the actual cost of similar historical projects
 - Present cost positions and reasons for differences at Agency PMC
 - Examples: JWST, TDRS, Phoenix, and MSL
- **Provide funds to support development of current cost estimating relationships (CERs) and supporting data**